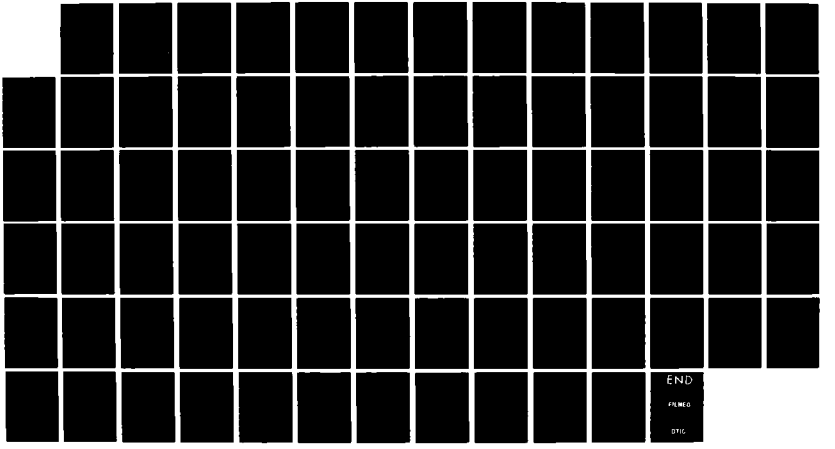
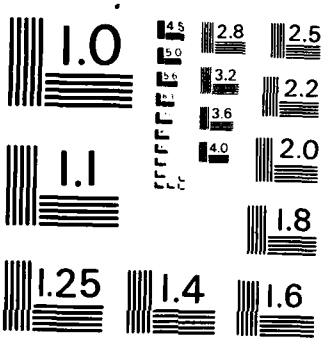
AD-A161 065 THE RAPID RISE IN THE COST OF REPLENISHMENT SPARE PARTS: ARE WE MAKING PROGRESS?(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. 1/1

UNCLASSIFIED J G GABLE SEP 85 AFIT/GLM/LSA/85S-25 F/G 15/5 NL





(2)

AD-A161 065

THE RAPID RISE IN THE COST OF REPLENISHMENT SPARE PARTS: ARE WE MAKING PROGRESS?

THESIS

Jerry G. Gable
Captain, USAF

AFIT/GLM/LSA/85S-25

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

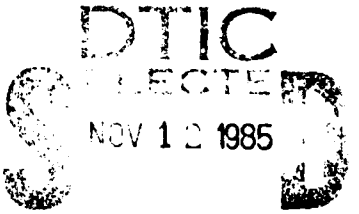
AFIT/GLM/LSA/85S-25

THE RAPID RISE IN THE COST OF REPLENISHMENT SPARE PARTS: ARE WE MAKING PROGRESS?

THESIS

Jerry G. Gable
Captain, USAF

AFIT/GLM/LSA/85S-25



B

The contents of the document are technically accurate, and no sensitive items, detrimental ideas, or deleterious information are contained therein. Furthermore, the views expressed in the document are those of the author(s) and do not necessarily reflect the views of the School of Systems and Logistics, the Air University, the United States Air Force, or the Department of Defense.

✓

A-1

AFIT/GLM/LSA/85S-25

THE RAPID RISE IN THE COST OF REPLENISHMENT SPARE PARTS: ARE WE MAKING PROGRESS?

THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Logistics Management

Jerry G. Gable, B.S.

Captain, USAF

September 1985

Acknowledgements

In performing the research and writing this thesis I have had a great deal of help from others. I am deeply indebted to my faculty advisor, Lt Col Matthew D. Shields, for his continuing patience and assistance throughout this effort. Additionally, I would like to thank Commander Rudolf P. Wiegand for his guidance concerning the application of statistical techniques as utilized in this research effort.

Table of Contents

List of Tables

AFIT/GLM/LSA/85S-25

Abstract

This research effort examined the results of recent attempts by the Air Force Logistics Command in reducing the price paid for replenishment spare parts. It examined trends in the procurement method used and prices paid for non-competitively procured parts as well for competitively procured parts.

The analysis was accomplished by examining procurement data for the Warner-Robins Air Logistics Center over two different periods. After adjusting the data for the effects of inflation it was examined with the following questions in mind:

1) Has AFLC been effective in reducing the portion of sole-source purchases that are negotiated with other than the actual manufacturer?

2) Does negotiating sole-source procurements with the actual manufacturer result in savings to the government?

3) Has AFLC been effective in increasing price competition in the acquisition of replenishment spare parts?

4) Does competitive procurement actually decrease the price paid for individual replenishment spare parts?

Results of this research effort indicate the following:

1) AFLC has thus far not been successful in reducing the portion of sole-source purchases that are negotiated with other than the actual manufacturer.

2) There appears to be no significant reduction in price associated with negotiating non-competitive procurements with the actual manufacturer.

3) AFLC has been successful in increasing price competition in the acquisition of replenishment spare parts.

4) Competitive procurement does appear to actually decrease the price paid for individual replenishment spare parts.

THE RAPID RISE IN THE COST OF REPLENISHMENT SPARE PARTS: ARE WE MAKING PROGRESS?

I. Introduction

Chapter Overview

This chapter introduces the general issue, which is the success of the Air Force Logistics Command in combating the rapid rise in costs of spare parts. It further introduces the research objectives and research questions, and specifies the scope of the research.

General Issue

The costs of buying and maintaining new weapon systems have increased rapidly in recent years. Due to funding constraints, these high costs have forced the Air Force to replace large numbers of aging systems with a smaller number of higher priced new systems.

Costs of replenishment spare parts (hereafter called "spares" for brevity) represent a significant portion of the total life-cycle costs of systems. In recent years, diminishing defense industrial production capability and the resulting lack of competition, combined with an unanticipated high rate of inflation, resulted in sharp increases in the prices paid by the Air Force Logistics Command (AFLC) for spares (11:1-2). The cost to the Air

Force for aircraft replenishment spares alone was $784 million in fiscal year 1980, $1,588 million in 1981, $2,449 million in 1982, and $2,441 million in 1983 (11:2-5). Not only has the rapidly rising cost of spares contributed to our inability to replace retired systems with an equal number of new systems, the high cost for spares has also brought about underfunding of spares requirements for both new and existing systems. As a result, Air Force readiness and sustainability have been severely affected (11:2-6). According to a recent study, "The availability of spares, both reparables and nonreparables, is the most significant determinant of Air Force readiness, and historically the greatest limiting factor" (11:2-2). "In recent years the Air Force has increasingly resorted to satisfying aircraft grounding conditions through cannibalization (removing parts from one aircraft for installation on another). For example, in FY82 the needed spares were available "off the shelf" to satisfy only 36% of grounding incidents" (11:2-10).

The high costs of spares accentuates the need to spend spares dollars in the most effective and prudent manner possible. It also highlights the importance of holding the price of spares to the lowest reasonable level possible.

Research Problem

It has been two years since the Congressional hearings on spare parts prices and since formation of the Air Force

Management Advisory Group (AFMAG) to study the spare parts problem. It is time to examine the success of efforts to control prices. Specifically, two key initiatives to control prices require consideration: (1) elimination of pass-through costs on sole-source purchases and (2) increased competition. An additional problem requiring research is the actual effect on price when the initiatives are successful.

Research Objectives

The objectives of this research effort, therefore, were to (1) assess the effectiveness of AFLC in reducing the portion of sole-source purchases that are negotiated with other than the actual manufacturer, (2) determine if negotiating sole-source procurements with the actual manufacturer results in savings to the government, (3) assess the effectiveness of AFLC in increasing price competition in the acquisition of spares, and (4) determine if competitive procurement actually decreases the price paid for individual spares items.

Research Questions

In order to fulfill the research objectives the following research questions were formulated:

Research Question One

Is AFLC making progress in purchasing more non-competitively procured items directly from the manufacturer?

Research Question Two

Does negotiating sole-source procurements directly with the actual manufacturer result in a reduced price for individual spares items?

Research Question Three

Has AFLC been successful in increasing the rate of price competition in the acquisition of spares items:

a) When considering all spares items procured in period one and all spares items procured in period two
b) When considering only items that were procured in both periods one and two
c) When considering spares items with small estimated annual procurement values?

Research Question Four

Has AFLC been successful in reducing the price paid for spares items when items have changed from non-competitive to competitive procurement?

Scope and Limitations of Research

There are many current initiatives within the Air Force designed to decrease acquisition costs and increase competition. There are also numerous ways to measure the effectiveness of these efforts. This research effort was limited to an examination of only the AFLC effort in reducing the cost of spares and increasing the overall competition in the acquisition of spares. Additionally, this research effort was limited to an examination of procurement actions performed by the Warner Robins Air Logistics Center (ALC) only. Each ALC performs a very large number of procurement actions yearly. While an examination of procurement actions of all five ALCs would have been

preferable, the data manipulation requirements for that type of exercise eliminated it from consideration for this research effort. Because of the above limitation it should be noted here that this research effort is necessarily limited to a "first look" assessment of the success of AFLC rather than a final judgement. However, as a first look the findings must be considered important because Warner-Robins ALC spends over 23 percent of the AFLC annual budget (10:1).

The study did not deal with the methods which caused the various results. Rather, the study merely examined the results themselves. Methods used in achieving goals such as increased competition are often quite complex, and while important, are beyond the scope of this analysis.

Summary

This chapter has introduced the general issue of the success of the Air Force Logistics Command in its fight against rapidly rising costs of spare parts. It also introduced the research objectives and research questions, and specified the scope of the research effort.

II. Literature Review

Chapter Overview

This chapter contains a brief definition of replenishment spares and a brief explanation of how they are procured. It also discusses the environment that led to the Air Force Management Analysis Group (AFMAG) Study, as well as some of the more important findings of that study effort. The AFMAG Study was important because it involved an in-depth examination of the entire spares acquisition process. The study identified many problems and made a number of near-term and long-term recommendations. Because of the depth of the study and because of the problems identified during the study, a summary of the more important AFMAG findings which impact competition and spares prices is included in the chapter. Reasons for advocating increased competition are presented, followed by a brief discussion about the creation and organization of the Directorate of Competition Advocacy, an important part of AFLC's strategy in promoting price competition.

Replenishment Spare Parts

Replenishment spares are defined as:

> ...items and equipment, both repairable and consumable, purchased by inventory control points, required to replenish stocks for use in the maintenance overhaul and repair of equipment such as ships, tanks, guns, aircraft, engines, etc. (17:583).

AFLC is the central procurement activity responsible for providing parts, maintenance, training, and general

logistics support for Air Force weapon systems after they become operational (16:13). AFLC works primarily through its five ALCs in performing central procurement actions in support of specific weapon systems. The five ALCs are Ogden, Oklahoma City, Sacramento, San Antonio, and Warner-Robins.

Developments Leading to AFMAG Study

"The period from 1978 through 1981 saw an overheated aircraft industry operating within a diminishing defense industrial supplier base" (11:1-2). This condition caused production lead time to increase significantly. In addition, during the same period the Air Force experienced high inflation rates which were not matched by the Office of the Secretary of Defense (OSD) inflation indices. "The combination of these two problems within the 1978-1981 time period caused an unprecedented growth in aircraft spare parts requirements" (11:1-2).

During this period, AFLC began to investigate the causes of the sharp increases in the costs of certain spares. "A series of internal studies, coupled with the 1982 public disclosure on engine spares price increases, led to a series of Congressional hearings (11:1-2).

AFMAG Study

It was in this environment of significant engine spare parts price increases that the Air Force Management Analy-

sis Group (AFMAG) was formed. The AFMAG-Spare Parts Acquisition Study was formed at the direction of the Secretary of the Air Force and the Air Force Chief of Staff on 20 May 1983. The actual study began on 14 June 1983 (11:1-1). The charter of the AFMAG required an in-depth study of the entire spares acquisition process and an assessment of the impact of their findings on the ability of the Air Force to procure adequate spares at fair and reasonable prices. Additionally, the AFMAG was to address both near-term and long-term initiatives to solve the overpricing problem. Near-term initiatives were defined as those actions that could be taken immediately to influence the FY 84 spares buy program (11:1-3). Long-term initiatives were all those actions which, while needed, could not be taken in time to influence the FY84 spares buy program.

The AFMAG-Spare Parts Acquisition Study was a large-scale project. It brought together sixty-two professionals to study the entire spares acquisition process. The AFMAG study capitalized on investigations and studies previously undertaken by numerous government agencies. In addition to a complete review of all available literature on the subject of spares, the AFMAG conducted numerous field visits and interviews. The group visited all five AFLC ALCs, four of the five AFSC Product Divisions, and many field contract administration offices. The AFMAG also held extensive interchanges with many field contract administration offices, and met with industry to receive their inputs on

how the Air Force could improve its business practices. The study was completed on 12 October 1983 with a final out briefing to the Secretary of the Air Force and Chief of Staff (11:1-1).

Because of the range of problems identified during the study, a summary of some of the more important AFMAG findings impacting competition and spares prices follows.

AFMAG Findings--Low Competition Rate. The AFMAG study found that the primary Air Force spares acquisition problem is a low overall competition rate which has produced high prices (11:2-12). Additionally, it found that the Air Force spares overall competition rate has declined from a high of 37.5% in 1973 to a low of 20.7% in 1982.

The AFMAG study identified the following as primary factors contributing to the low competition rate:

Fielding of new weapon systems
Inadequate/missing engineering data
Proprietary rights
Data management
Shrinking industrial base
Bureaucratic process (11:Figure 2-16)

Significant AFMAG findings on each of these factors follows:

Fielding of New Weapon Systems. The overall competition rate in the procurement of new weapon systems ranged between five and eight percent during the FY78-FY82 period. Additionally, little effort had been devoted to obtain competition in purchasing the parts supplied for

these systems.

Inadequate/Missing Engineering Data. Technical and engineering data, even for recently acquired systems such as the F-15 and the A-10, were not generally available to support competitive spares purchasing. Competitive spares acquisition was also being restricted because prime contractors were not required to flow down data requirements and data rights clauses to subcontractors.

Proprietary Rights. When a contractor asserted that a part, component, or process was developed at private expense, data was delivered to the Air Force with limited rights. This restriction precluded the use of the data for competitive spares purchasing. Additionally, the Defense Acquisition Regulation (DAR) did not adequately define "developed at private expense" for use in determining whether engineering data is proprietary. This permitted relatively unconstrained use of restrictive markings which inhibited competitive acquisition. Further, limited data rights claims were not adequately challenged for validity because the Air Force did not have sufficient technical and engineering resources to accomplish these reviews.

Data Management. Engineering and reprocurement data were often delivered earlier than needed and while designs were still unstable. In addition, acceptance procedures tended to focus on format rather than usability. Another complication was the use by the major storage

repositories of manual retrieval methods which lead to errors. Interviews and audit reports indicated a ten percent error rate in the manual processing of data (11:2-8). The lack of an Air Force policy to require contractors to warrant that acquisition data packages were complete, accurate, and adequate for competitive spare parts acquisition also resulted in recurring problems.

Shrinking Industrial Base. There has been a steady reduction in the number of firms actively participating in the defense industry in recent years. The AFMAG Study outlined the following as primary reasons for this reduction:

a) Relatively low profit margins as compared with comparable civilian sector work.

b) Relatively high levels of administrative requirements.

c) A reduction in the level of defense expenditures during the post-Vietnam era.

d) Environmental protection legislation which often requires extensive capital investment.

Bureaucratic Process. Numerous regulatory and legal constraints existed which tended to inhibit competition. It was often difficult, time consuming, and costly for new suppliers to become qualified to do business with the Department of Defense.

AFMAG Findings--Price Increase Factors. The AFMAG Study identified the following as primary factors that tend

to increase the prices paid for spares (11:23-34):

Initial provisioning methodology
Underfunding
Pricing methodology
Pass through costs
Cost allocation methodology

Significant AFMAG findings on each of these factors are summarized below.

Initial Provisioning Methodology. Contractors were instructed by MIL-STD 1552 to provide their provisioned item order price estimates based on unit number one of the learning curve without regard to minimum buy quantities or the economies of the ongoing production run. Estimates therefore often included costs of special tooling, machine, set-up costs, and performance testing to name only a few. Negotiating the total order price in this manner resulted in a distortion of the individual item prices. Another problem associated with initial provisioning concerned the fact that the initial provisioned price estimate, rather than the actual negotiated price, was entered into Air Force catalog lists and is used to charge stock fund customers - the Air Force operational units. This resulted not only in a cash flow drain to the stock fund customer but also gave the impression of overpricing when that might not have been the case.

Underfunding. Underfunding resulted in restrictive buy guidelines in order to limit annual investment costs. These restrictive buying guides resulted in many

repetitive, small quantity buys. Making many repetitive small quantity buys resulted in higher prices and an increased workload for contracting offices.

Pricing Methodology. Substantial personnel reductions, coupled with a large number of actions in the low value category, resulted in the use of individual pricing of only a portion of items procured in recent years. While this method was designed to facilitate processing a large number of purchases with a minimum number of contracting personnel, the potential is great for paying significantly overstated prices for relatively low value items bought in small quantities. An additional problem was the practice of accepting a current or proposed price as fair and reasonable based on a comparison with historical prices. This method assumes that the last price paid was fair and reasonable. This assumption is so widely accepted that the buyer's analysis was often accomplished with little or no knowledge of the item itself. Without knowledge of the item, reliance on previous prices paid could easily result in paying unreasonable prices.

Pass Through Costs. Prime contractors often subcontracted for parts they had agreed to deliver to the Air Force. These subcontracted parts were often complete as delivered to the prime contractor. When the prime contractor added little or no value to the parts, the costs the prime added to the vendor's price for pass through to the

Air Force were not in return for any value added. One ALCs analysis of pass through costs revealed mark-ups that ranged from 28% to 250% added to the vendor's price (11: Figure 2-29). These pass through costs contributed significantly to the unit price the Air Force paid.

Cost Allocation Methodology. This problem primarily concerned a misrepresentation of prices paid rather than any true overpricing. Misrepresentation resulted because of the way many prime contractors allocated expenses to spares. Most prime contractors allocated direct and indirect expenses to spares whether or not those specific expense pools contributed to the production of the specific spares. In addition, many major defense contractors prorated their costs equally to each line item of the spares order rather than an allocation based on the price or cost of the item. While this was not a problem with orders containing items which are all of approximately the same value it led to a tremendous distortion of price paid when the order contained both expensive and inexpensive items. For a simplified example, assume the Air Force buys the following items on different orders:

5 machine screws (valued at $.08 each)
1 rectifier (valued at $200)

If the contractor allocates overhead costs totaling $120.00 equally to individual units regardless of the cost of the item, then each machine screw would bear one-sixth of the $120.00 or $20. The total charged to an order of five

would be $100.00 The rectifier would bear $20.00 of the overhead. The price of each screw would be $23.09, as illustrated in Table 1.

TABLE 1

EQUAL LINE ITEM PRORATION BASIS

	machine screw	rectifier
Purchased part 5@ $.08	$ .40	1@ $200 $200.00
Overhead	100.00	20.00
	100.40	220.00
Profit 15%	15.06	33.00
Total Price	$115.46	$253.00
Unit price	$ 23.09	$ 253.00

On the other hand, if the contractor allocates overhead costs totaling $120.00 to the purchased parts based on dollar value, then each machine screw is priced at $ .15, as illustrated in Table 2. It is important to note that under either method the total government cost is the same.

TABLE 2

VALUE ALLOCATION BASIS

	machine screw	rectifier
Purchased part	$ .40	$200.00
Overhead	.24	119.76
	.64	319.76
Profit 15%	.10	47.96
Total Price	$ .74	$367.72
Unit price	$ .15	$367.72

AFMAG Recommendations. The AFMAG made numerous specific recommendations in each of the areas discussed above. These recommendations were designed to alleviate the problems existing in managing spares currently in the Air Force inventory. The AFMAG also made numerous recommendations on how to improve the management of the weapons systems development/acquisition process. However, as was stated above, low overall competition was identified as the primary problem affecting spares prices.

Government Position on Competition

Competition is often advocated as a method to help ensure that spares prices are held down to the lowest reasonable level. This view is held by many, and indeed, competition is the preferred procurement method of the United States Government. Numerous studies have been performed which compare sole-source procurement costs with

competitive procurement costs. A 1972 US Army Electronics Command study concluded that introducing competition into a sole-source procurement environment would result in an expected acquisition cost savings of 40 percent to 50 percent (19:19). A 1974 Air Force Institute of Technology master's thesis investigated the effect of competition on the cost of aircraft replenishment spares. The study concluded that the net savings accompanying a shift from sole-source to competitive procurement is a function of gross savings in procurement dollars and the increased costs involved. Relevant costs identified included procurement data costs, administrative costs, quality costs, and reliability costs. Net savings ranged from 10.85 percent to 17.5 percent (4:43). Another Air Force Institute of Technology master's thesis performed in 1984 concluded that competitive procurement does indeed reduce the price of items purchased over sole-source procurement, and further that as the number of quotations received increases, the relative price paid for an item decreases (1:53).

However, the Government position is that competition can do more than ensure reasonable prices. A Defense Systems Management College publication states that "Competition is not advocated merely for the sake of competition, but rather it is advocated as a means to enhance the overall value of weapon systems procurement to the government, considering the economic, technical, schedule, and logistics effects" (6:1-1).

The DOD and the Congress have long preferred competition as a means of controlling weapon system costs and ensuring a fair procurement system. This preference is expressed through legislation, regulations, and instructions. For example, "the Armed Services Procurement Act of 1947 requires that contracts for property or services be formally advertised, and allows negotiation only under specific situations" (6:1-3). DOD Directive 4245.9 states, "It is DOD policy that goods and services shall be acquired on a competitive basis to the maximum extent practicable as a means of achieving economic, technical, schedule, and supportability benefits" (5:1). The President himself addressed the need for more competition with a memorandum to the heads of Departments and agencies stating "Competition is fundamental to our free enterprise system. It is the single most important source of innovation, efficiency, and growth in our economy" (15:1). A Federal Procurement Policy (OFPP) policy letter, dated 27 February 1984, states, "It is important that we obtain the benefits of competition--economic, technological, and managerial--to the maximum practical extent. This policy letter focuses existing agency direction more effectively and requires procurement officials to take greater advantage of competitive opportunities" (14:2). Air Force Regulation 800-35 establishes a Competition Advocate Program for the Air Force and outlines general policies for programs at the

command level (7:1).

Creation of AFLC Directorate of Competition Advocacy

In keeping with the above guidance, and the generally increased emphasis on competition, AFLC established the Directorate of Competition Advocacy in July of 1983. While a small competition advocacy effort had been underway in the Air Force since January 1982, the creation of the Directorate of Competition Advocacy greatly increased the level of effort in this area. The AFLC Directorate of Competition Advocacy responsibilities include:

1) Promotion of competition in the acquisition process
2) Performance of price screening
3) Performance of item screening for breakout/competition
4) Management of engineering data
5) Source development
6) Supplier interface (8:1)

The AFLC Directorate of Competition Advocacy, as can be seen from the above list, is responsible for a diversified range of tasks and initiatives.

Gaps in the Literature

The AFMAG Study provided a wealth of findings which could form the basis for a very large follow-on research effort. There has been limited research into DOD actions to improve spares acquisitions, but no research specifically concerning efforts undertaken as a result of the AFMAG Study. Due to time and resource constraints this research effort required the selection of several key

research questions from the many potential questions afforded by the AFMAG Study. The research questions identified in Chapter One were formulated to examine the results of a concentrated AFLC effort to move spares procurement sourcing away from reliance on the system's prime contractor.

Summary

This chapter presented a brief overview of the spares procurement process, as well as a review of the AFMAG Study and some of the more important findings that came out of that study. The Government position on competition was also presented, followed by a brief discussion about the creation and responsibilities of the AFLC Directorate of Competition Advocacy. Gaps in the literature related to the research problem and objectives were identified, thus supporting the need for the research.

III. METHODOLOGY

Overview

As previously stated, the primary research objectives were to (1) assess the effectiveness of AFLC in reducing the portion of sole-source purchases that are negotiated with other than the actual manufacturer, (2) determine if negotiating sole-source procurements with the actual manufacturer results in a savings to the government, (3) assess the effectiveness of AFLC in increasing price competition in the acquisition of spares, and (4) determine if competitive procurement actually decreases the price paid for individual spares items. Chapter III discusses the specific research methodology employed to accomplish the research objective. The chapter also discusses the data base used, data adjustments, and statistical techniques employed. In order to attain the research objectives, four research hypotheses were developed. The research questions and associated hypotheses are listed along with a brief explanation of the author's rationale for the expected outcome of each hypothesis.

Acquisition Due-In System -- Special Report

General Description of Report. The primary source of information for this research project was the Acquisition Due-In (J041) System. Whenever replenishment spare parts are purchased, the ALC responsible for procuring the part

updates a procurement history file with a number of pertinent facts (2:37). Data maintained in the procurement history files includes information such as national stock number, purchasing office, order quantity, price, contracting priority, actual method of contracting, and number of firms solicited.

A special report was generated from information contained in the Acquisition Due-In System to serve as a basis for this research effort. This report contained information on 48,126 procurement actions involving replenishment spare parts procured by the Warner Robins ALC in two different periods.

Warner Robins ALC was chosen to study over the other ALC's because, according to Mr. Stephen Stitzell, a procurement analyst assigned to the Office of Assistant to the Commander for Competition Advocacy, Air Force Logistics Command, the types of items procured by the Warner Robins ALC are representative of normal AFLC procurement actions (18). Additionally, Warner Robin's activities represent a significant portion of total AFLC expenditures for spares.

Period one included procurement actions which took place from August 1982 through July 1983, inclusive, and period two covered actions taking place from October 1983 through September 1984, inclusive. The periods were selected to correspond with the upgrading of the AFLC Directorate of Competition Advocacy because the AFLC

Directorate of Competition Advocacy is a major AFLC tool in the fight against the high costs of spares items. Period one dates were chosen to reflect information on spares pricing and competition rates prior to establishment of the AFLC Directorate of Competition Advocacy. Period two dates were chosen to reflect information on spares pricing and competition rates subsequent to establishment of the AFLC Directorate of Competition Advocacy.

Ideal dates for period one and period two were difficult to establish because of the number of activities taking place in this time period concerning competition initiatives. Mr. Stephen Stitzel indicated that the best date to use for establishment of the AFLC Directorate of Competition Advocacy would be October 1983 (19). The two month break between period one and period two was used to preclude evaluating data during this period of rapid activity and changing guidance on competition advocacy.

The special report contained items that were procured only in period one, items that were procured in both periods, and items that were only procured in period two.

Items Excluded From the Special Report. In order to eliminate data which might distort the comparison between periods one and two, the following types of items were excluded from the special report:

Initial Provisioning Items - Initial provisioning is "the process of determining the range and quantity of

items required to support and maintain an item for an initial period of service. Its phases include the identification of items of supply, the establishment of data for catalog, technical manual and allowance list preparation, and preparation of instructions to assure delivery of necessary support items with related end articles " (17:348).

First Articles - First articles include "preproduction models, initial production samples, test samples, first lots, pilot models, and pilot lots; and approval involves testing and evaluating the first article for conformance with specified contract requirements before or in the initial stage of production under a contract" (17:293). First article items therefore include many one-time costs and because of this were excluded from analysis.

Repair/Maintenance - Cost of repair and/or maintenance on items is dependent upon the extent of the repair or maintenance being performed and is not comparable to the acquisition cost for similar like items. All repair and/or maintenance actions were therefore excluded from analysis.

Procurements of Items With Estimated Prices - Estimated prices are used for procurement actions when the items are used prior to determination of the actual price. Estimated prices are therefore often not representative of the actual price.

Special Purchases - AMOC stands for "Actual Method of Contracting". Each procurement action is assigned an AMOC Code of 0 through 5. Procurement actions

are coded with 0 AMOC code only when the actions are considered as special purchases. Because of the unique nature of these actions all procurement actions coded AMOC 0 were excluded from analysis. The other AMOC Codes are explained on the following page.

Items Included in the Special Report. Specifically, the special report contained the following information for each buy of an item which occurred in either period one or period two:

National Stock Number - This is a unique 13 digit, two-part number assigned to each item of supply repetitively used, purchased, stocked or distributed within the Federal Government (17:466). The first part, four digits, of the number consists of the Federal Supply Classification (FSC). The FSC divides the universe of items of supply into broad commodity groups (17:287). The second part of the number consists of nine numerals and is known as the National Item Identification Number (NIIN). The NIIN is a nine-digit number assigned to each item of supply assigned or approved National Item Identification. The NIIN is assigned serially without regard to name, description, or Federal Supply Classification group or class, but denoting country of origin. The NIIN differentiates an individual item of supply from all other items of supply (17:465).

Award Date - This is the award date of each specific procurement action.

Quantity Procured - This reflects the actual quantity purchased by the respective procurement action.

Price Paid - This reflects the contract price for the quantity purchased in the specific procurement action.

Actual Method of Contracting (AMOC) - This code is used to indicate the actual method used to contract for specific purchases of spares. AMOC codes are assigned as follows (10:Attachment 1):

AMOC Number	Explanation
1	Current purchase is competitive, and the item was previously purchased competitively
2	Current purchase is competitive, and the item is being purchased competitively for the first time
3	Current purchase is non-competitive from the actual manufacturer or a vendor, including a prime contractor who is the manufacturer
4	Current purchase is non-competitive, and the item is being purchased directly from the actual manufacturer or vendor for the first time rather than the original prime contractor for the end items for which the parts support
5	Current purchase is non-competitive, and the item is being purchased from a prime contractor who is not the actual manufacturer

Summary of Data in Special Report. Table 3 is a summary, by purchase period and AMOC, of the total number of procurement actions and the total dollar value of those

actions analyzed during this research effort.

TABLE 3

SUMMARY OF SPECIAL REPORT

AMOC #	Number of Procurement Actions	Items	Total Value of Actions
	Period 1		
1	2957	1,575,908	$ 44,862,157
2	1100	341,014	30,944,892
3	14834	1,779,169	321,324,869
4	83	4,615	1,854,317
5	2728	608,111	35,635,394
Total	21702	4,308,817	$434,621,629
	Period 2		
1	4393	2,232,620	86,888,407
2	1908	391,362	30,616,624
3	16126	2,099,287	194,091,040
4	389	41,936	6,181,300
5	3608	670,840	34,617,365
Total	26424	5,436,045	$352,394,736

While the above is a summary of the data that was analyzed in this research effort, it is difficult, and may be misleading, to draw conclusions from comparisons of these numbers alone. For example, dollar values have not been adjusted for inflation and no consideration has been given to the impact of changes in the mix of items procured in the two periods. The adjustment for inflation used in

the research is outlined in the next section. Specific data selection techniques used for individual hypotheses are explained in the discussion of each specific hypothesis.

Adjustment for Inflation. The dollar values as reported above reflect prices that prevailed at the time of the procurement. Prior to performing any analysis on this data an adjustment was made for the effect of inflation. Previous analysis performed by Bass and Schmitt in their 1984 Air Force Institute of Technology thesis indicated that the Producer Price Indexes (PPI) for special metal and metal products was the single best index to use for adjusting spare parts prices for inflation (1:36). According to their findings, 92.5 percent of the 4456 items they tested were best classified as metal products. Based on this finding, the special metal and metal products index was used to develop quarterly deflation factors for adjustment of data prior to analysis. Table 4 illustrates development of the base period.

TABLE 4

DEVELOPMENT OF BASE PERIOD

Month/Yr	PPI Index	Deflation Factor
Aug 82	285.8	
Sep 82	284.0	
Oct 82	289.5	
Total	859.3	1 (859.3/859.3)

All quarterly deflators were developed by summing the appropriate monthly PPI Index numbers and then dividing the sum by 859.3 (the sum of the PPI Index numbers for the base period). Table 5 illustrates the method used to develop these quarterly deflation factors. The table indicates that, on average, the prices in the second data quarter were .8 percent higher than in the first data quarter.

TABLE 5

EXAMPLE OF DEVELOPMENT OF DEFLATION FACTORS

Month/Yr	PPI Index	Deflation Factor
Nov 82	288.9	
Dec 82	288.7	
Jan 83	288.6	
Total	866.2	1.008 (866.2/859.3)

Table 6 lists the quarterly deflators developed from the monthly inflation indices provided in the PPI (3).

TABLE 6

QUARTERLY DEFLATORS

Period	Deflation Factor
ONE	
Aug 1982 - Oct 1982	Base of 1.00
Nov 1982 - Jan 1983	1.008
Feb 1983 - Apr 1983	1.015
May 1983 - Jul 1983	1.020
TWO	
Oct 1983 - Dec 1983	1.035
Jan 1984 - Mar 1984	1.043
Apr 1984 - Jun 1984	1.050
Jul 1984 - Sep 1984	1.044

Using a FORTRAN program on a CYBER computer, the prices for each procurement action were adjusted to base quarter dollars by dividing the actual price by the appropriate deflator. This enabled comparison of all procurement actions using base period dollars. Table 7 illustrates the procedure used to make adjustments for inflation.

TABLE 7

EXAMPLE OF ADJUSTMENTS FOR INFLATION

Period	Deflation Factor	Price	Adjusted Price
Aug 82-Oct 82	1	$100	$100/1=$100.00
Nov 82-Jan 83	1.008	$100	$100/1.008=$99.21
Feb 83-Apr 83	1.015	$100	$100/1.015=$98.52

Note: The actual calculations were taken to seven significant digits.

Statistical Techniques

Statistical techniques utilized in support of this research effort included stepwise log-linear analysis, tests of population proportions, t-tests, and paired difference t-tests about the difference between two sample means.

Log-linear analysis was used as a method of determining the overall level of data dependence. Tests of proportions, t-tests, and paired t-tests were used to determine the significance of differences between sample population means in support of individual hypothesis tests.

Perhaps the biggest problem in building a model is choosing the important variables to be included in the model. The list of potentially important variables can be long, and some objective method of screening out those variables that are not important is needed. Stepwise analysis fills this need (13:570). In stepwise analysis the

computer is used as an aid in developing the model. Several different stepwise techniques are available. In the forward selection method the computer fits all possible one-variable models to the data. After determining the best one-variable predictor of response the stepwise program searches through the remaining variables for the best two-variable model. After determining the best two-variable model the computer continues adding variables to the model until it produces a model containing only those terms with values that are significant at the specified level (17:391). The backward elimination method works in reverse of the forward selection method. Here the program begins by calculating statistics for a model including all the variables. Then the variables are deleted from the model one by one until arriving at a model containing only those terms with values that are significant at the specified level (17:391).

Tests of population proportions involve random samples of populations. The objective is to use this sample information to make an inference about the difference between two populations (13:371).

T-tests are often used to test hypotheses concerning the difference between two population means (13:328). Using this technique paired observations are made of samples of two populations. The differences between these paired observations are then analyzed, and, in so doing, inferences are made about the mean of the population of

differences (13:361).

The first step in analyzing the data for this research effort, before performing any individual hypothesis tests, was to determine the level of overall data dependence using four-way log-linear analysis. The variables were price, period, quantity purchased, and AMOC Code. Stepwise analysis was utilized in an attempt to determine the important variables to include in the log-linear model. The "BMDP-4F" statistical package maintained on the CYBER computer was used as an analysis tool in support of this effort. Results of the overall data dependence test are contained in Chapter IV.

All statistical tests were performed at the .10 level of significance to reasonably minimize the possibility of rejecting the null hypotheses (Ho) when they were true.

Research Hypotheses

The following section discusses the research hypotheses that were developed to satisfy the research objectives and the individual research questions which were presented earlier:

Research Question One:

Is AFLC making progress in purchasing more non-competitively procured items directly from the actual manufacturer?

Research Hypothesis One:

Of the total population of non-competitive procurement actions, the percentage of actions negotiated with the actual item manufacturer differed in periods one and two.

Recent emphasis has been placed on reducing pass-through cost, especially in instances where the prime contractor adds little or no value to the item. One method of reducing pass-through cost is to buy the item directly from the actual manufacturer. The author would expect a shift towards procuring non-competitively purchased items directly from the actual manufacturer in period two due to efforts by the Engineering Data Management Division of the AFLC Directorate of Competition Advocacy to break-out items for direct purchase or competition.

A test of population proportions was used to test this hypothesis. Results of this test are contained in Chapter IV.

Research Question Two:

Does negotiating sole-source procurements directly with the actual manufacturer result in a reduced price for individual spares items?

Research Hypothesis Two:

When sole-source procurements were negotiated with the actual manufacturer the price paid per spares item decreased.

When sole-source items previously purchased through a middle man are switched to direct procurement from the actual manufacturer, a reduction in price should follow

which would reflect the elimination of the pass-through cost associated with using the middle man.

A FORTRAN program was used to extract the pertinent data from the special J041 report and then sort it for this hypothesis test. A paired t-test was then used to test the hypothesis. Results of the test are in Chapter IV.

Research Question Three:

Has AFLC been successful in increasing the rate of price competition in the acquisition of spares items:

a) When considering all spares items procured in period one and all spares items procured in period two
b) When considering only items that were procured in both periods one and two
c) When considering spares items with small estimated annual procurement values?

Research Hypothesis Three-A:

The rate of price competition increased in period two, based on a comparison of the number of competitive procurement actions to the number of all procurement actions.

Research Hypothesis Three-B:

Considering only items procured in both periods one and two, the rate of price competition increased in period two.

Research Hypothesis Three-C:

The rate of price competition for spares items with an annual procurement value of less than $10,000 increased in period two.

A lack of adequate price competition was identified by the AFMAG Study as the primary problem which produced high spares prices. Additionally, the AFMAG Study pointed out

that there was no current requirement at the time of the study to screen any item with an annual estimated procurement value of less than $10,000. This resulted in lost opportunity for competition and created a high potential for "horror" cases (12:148).

Due to efforts by the AFLC Directorate of Competition Advocacy to increase the rate of price competition the author would expect to see an increase in the percentage of competitive procurement actions. Looking at this question in three different ways provides greater insight into changes in the rate of price competition.

A test of population proportions was used to test hypothesis Three-A. Hypothesis Three-B and Three-C also used a test of population proportions, but both first required the use of a FORTRAN program to extract the pertinent data from the special J041 report and sort it. Results of these tests are contained in Chapter IV.

Research Question Four:

Has AFLC been successful in reducing the price paid for spares items have changed from non-competitive to competitive procurement?

Research Hypothesis Four:

A change from non-competitive to competitive procurement resulted in a decrease in the price paid per unit.

If competition does indeed reduce prices then we should expect a reduction in the average inflation-adjusted price per unit paid as AFLC shifts to procurement by competition.

A FORTRAN program was used to extract the pertinent data from the special J041 report and then sort it. A paired t-test was then used to test this hypothesis. Results of the test are contained in Chapter IV.

Summary

Chapter III discussed the specific research methodology used to accomplish the research objective. It discussed the data base used for analysis, as well as adjustments made to the data and a brief discussion of statistical techniques used. Hypotheses were listed along with a brief explanation of the testing method for each hypothesis. The author's rationale for the expected outcome of each hypothesis was also presented.

IV. Data Analysis and Findings

Introduction

Chapter IV presents the summary of the price adjusted raw data used for this research, results of the analysis of the overall data dependency test described in Chapter III, and results of the individual tests performed for each hypothesis. The author's interpretation of the results are also included.

Results of Analysis

Summary of Deflated Data. Table 8 summarizes the procurement actions and total inflation adjusted dollar values of sampled procurement actions for both periods one and two.

TABLE 8

SUMMARY OF ACTIONS AND TOTAL DOLLAR VALUES

		Competitive	Non-Competitive	Totals
Period 1	actions	4057	17645	21702
	dollars	$74,945,553	$354,732,168	$429,667,721
Period 2	actions	6301	20123	26424
	dollars	$112,589,870	$225,188,287	$337,778,157

Table 9 summarizes the above data as percentages of the totals for each period.

TABLE 9

SUMMARY OF ACTIONS AND TOTAL DOLLAR VALUES AS PERCENTS

		Competitive	Non-Competitive	Totals
Period 1	actions	18.7%	81.3%	100%
	dollars	17.4%	82.6%	100%
Period 2	actions	23.8%	76.2%	100%
	dollars	33.3%	66.7%	100%

Table 10 presents the period two data (from Table 8) as percentages of period one.

TABLE 10

SUMMARY OF PERIOD TWO AS PERCENTAGES OF PERIOD ONE

		Competitive	Non-Competitive	Totals
Period 1	actions	100%	100%	100%
	dollars	100%	100%	100%
Period 2	actions	155.3%	114.0%	121.8%
	dollars	150.2%	63.5%	78.6%

Results of Overall Data Dependence Test. After generating the special report, eliminating those items which would bias the data, and adjusting the remaining data for inflation, the next step was to determine the extent of interaction between the variables of interest. Four-way

log-linear analysis was chosen for this purpose.

The first step in the analysis process was to segregate the data into different categories (using a FORTRAN program). All data on individual procurement actions was segregated by:

Period - Procurement actions were identified as having taken place in either Period One or Period Two.

Quantity - Procurement actions were segregated into three categories based on the quantity of items procured per procurement action:

1) Less than 25 items were procured.
2) Between 25 and 99 items were procured.
3) One hundred or more items were procured.

Price - Procurement actions were segregated into three categories based on the price paid for individual items:

1) Price per item was less than $100.
2) Price per item was $100 to $999.
3) Price per item was $1000 or more.

AMOC Code - Procurement actions were segregated into one of five categories based on the AMOC code identified with the procurement action.

The above categories allow ninety possible combinations:

Period	x	quantity	x	price	x	AMOC	=	possible combinations
(2)	x	(3)	x	(3)	x	(5)	=	90

The second step in the log-linear analysis process was to employ both forward selection and backward elimination stepwise techniques using BMDP-4F in an attempt to determine important variables to be included in a model. Analysis of the output generated using BMDP-4F revealed the full model involving significant interaction between all variables, including third order interactions, at all levels

using a 90% confidence level. Unfortunately, this significant interaction between all variables complicates the interpretation of any statistical analysis concerning the individual hypotheses that follow. Careful consideration of the interactions between variables was therefore necessary in interpreting the results of all individual tests. Table 11 summarizes the categorical data analyzed.

TABLE 11

SUMMARY OF CATEGORICAL DATA TESTED

Year	Quantity	Price	AMOC 1	2	3	4	5	Total
1	1	1	304	101	2341	13	423	3182
		2	626	322	3957	22	748	5675
		3	260	182	2793	13	291	3539
		Total	1190	605	9091	48	1462	12396
	2	1	406	117	2107	16	485	3131
		2	319	140	1150	8	260	1877
		3	41	18	329	3	43	434
		Total	766	275	3586	27	788	5442
	3	1	859	174	1791	6	409	3239
		2	126	38	300	1	60	525
		3	16	8	66	1	9	100
		Total	1001	220	2157	8	478	3864
2	1	1	378	128	4193	49	611	5359
		2	866	515	3394	72	905	5752
		3	301	266	1827	43	386	2823
		Total	1545	909	9414	164	1902	13934
	2	1	581	255	2816	97	715	4464
		2	546	220	1053	36	264	2119
		3	78	44	258	12	27	419
		Total	1205	519	4127	145	1006	7002
	3	1	1394	400	2219	74	633	4720
		2	229	62	329	4	60	684
		3	20	18	37	2	7	84
		Total	1643	480	2585	80	700	5488

Results of Hypothesis One:

Of the total population of non-competitive procurement actions, the percentage of actions negotiated with the actual item manufacturer differed in periods one and two.

To test this hypothesis it was necessary to identify

the total number of non-competitive procurement actions in both periods one and two involving (a) the actual manufacturer and (b) other than the actual manufacturer. These procurement actions can be identified on Table 11. AMOC codes 3 and 4, as described earlier, identify non-competitive procurement actions involving items purchased from the actual manufacturer. AMOC code 5 identifies non-competitive procurement actions involving items purchased from other than the actual manufacturer. A summary of the data used for the test of population proportions is presented in Table 12.

A test of population proportions in support of hypothesis one indicated that there was a difference between the sample proportions of non-competitive procurement actions which were negotiated with the actual item manufacturer in periods one and two. Unfortunately, the sign (positive) of the t-statistic does not substantiate the author's expectation of a shift towards procuring non-competitively purchased items directly from the actual manufacturer in period two. Instead, the direction is a moderate shift (from 15.5% of total non-competitive actions in period one to 17.9% in period 2) towards procuring non-competitively purchased items from other than the actual manufacturer. Because of the previously mentioned extensive interaction between variables it may be misleading to look at these results in isolation. One possible explanation for this shift, when looking at other trends, is the overall reduc-

tion during period two in dollar value of total sampled non-competitive procurements as a percentage of all sampled procurements. While the total dollar value of all sampled non-competitive actions was 81.3% of all actions (from Table 9) in period one, non-competitive actions accounted for only 66.7% of the total dollar value of all sampled actions in period two. In addition, the total dollar value of non-competitive procurements decreased in real terms from $354,732,168 in period one to $225,188,287 in period two (from Table 8). So while there was a shift towards procurement of a larger proportion of non-competitive items from other than the actual manufacturer, the total dollar value of all non-competitive actions decreased significantly. This may indicate a greater emphasis on procuring items competitively than on procuring non-competitive items directly from the actual manufacturer. Results of the test are presented in Table 13.

TABLE 12

SUMMARY OF NON-COMPETITIVE PROCUREMENT ACTIONS

Period	Number of Actions	
	Actual Manufacturer	Other Than Actual Manufacturer
1	14917	2728
2	16515	3608

TABLE 13

RESULTS OF HYPOTHESIS ONE

t-Score	Result
6.254	Reject Ho

Ho: The percentage of all non-competitive procurements of spares that were negotiated with the actual contractor was the same in periods one and two.

Ha: The percentage of all non-competitive procurements that were negotiated with the actual contractor was different in periods one and two.

Rejection Region: $t < -1.645$ or $t > 1.645$.

Results of Hypothesis Two:

Negotiating sole-source procurements with the actual manufacturer results in lower prices than negotiating sole-source procurements with other than the actual manufacturer.

A FORTRAN program and a paired t-test were used in testing hypothesis two. The FORTRAN program performed the following steps:

1) Identified only items (by NSN) that were procured non-competitively. Only non-competitive items which were procured from other than the actual manufacturer were identified in period one, and only non-competitive items which were procured from the actual manufacturer were identified in period two. The program handled multiple procurements of an individual item in the same period by selecting for comparison only the last appropriate buy in period one and the first appropriate buy in period two. All items were discarded from consideration unless procurements were made in both periods, the procurement in period one was non-competitive and from other than the actual manufacturer, and the procurement in period two was non-competitive and from the actual manufacturer.

2) Calculated the cost per item procured (in base period dollars) for both the period one and period two actions.

3) Calculated the difference between the price paid in period one and period two per item by subtracting the price of the procurement in period two from the price of the procurement in period one.

The program identified 381 items which were procured both periods and met the above criteria. Having developed a difference for each selected item, a paired t-test was performed (utilizing a BMDP3D statistical package) to test the hypothesis.

A paired t-test of hypothesis two resulted in a failure to reject Ho in favor of Ha. Therefore, the test provides insufficient evidence to prove that procuring sole-source

items directly from the manufacturer translates to a reduction in price. Results of the paired t-test are presented in Table 14.

TABLE 14

RESULTS OF HYPOTHESIS TWO

Sample Size	t-Score	Result
381 pairs 1	1.18	Failure to Reject Ho

Ho: There is no difference in price between non-competitive purchases negotiated with the actual manufacturer and non-competitive purchases negotiated with other than the actual manufacturer.

Ha: Negotiating sole-source procurements with the actual manufacturer results in lower prices than negotiating sole-source procurements with other than the actual manufacturer.

Rejection Region: $t > 1.282$

1 In this instance a pair means a non-competitive procurement action in period one that was negotiated with other than the actual manufacturer, accompanied by a non-competitive procurement action that was negotiated with the actual manufacturer in period two.

Results of Hypothesis Three-A:

The rate of price competition increased in period two, based on a comparison of the number of competitive procurement actions to the number of all procurement actions.

No additional data retrievals were needed to test this hypothesis. The data required was the same as the data

presented earlier in Table 8.

A test of population proportions, using the information presented in Table 15, and the supporting t-test, indicated that there was an increase in the rate of price competition in period two. The rate of price competition increased from 18.7% of all sampled procurement actions in period one to 23.8% in period two, representing a 27.3% increase (from Table 10). Again, because of significant interaction between all variables it was important to examine other trends in interpreting this outcome. In this instance the proportion of the total dollar value of all procurements that was coded as competitive procurements also increased significantly, from 17.4% in period one to 33.3% in period two (from Table 9), representing a 91.4% increase. To summarize, of the total sample population of all procurement actions, the proportion of both (1) the number of procurement actions and (2) the dollar value of procurement actions coded as competitive increased dramatically in period two. A summary of procurement actions used to test this hypothesis is presented in Table 15 and results of the test are presented in Table 16.

TABLE 15

SUMMARY OF ALL PROCUREMENT ACTIONS

Period		Competitive	Non-Competitive
1	actions	4057	17645
	dollars	$74,945,553	$354,732,168
2	actions	6301	20123
	dollars	$112,589,870	$225,188,287

TABLE 16

RESULTS OF HYPOTHESIS THREE-A

t-Score	Result
-13.852	Reject Ho

Ho: The rate of price competition was the same in period two as in period one, based on the number of competitive procurement actions.

Ha: The rate of price competition was greater in period two than in period one, based on the number of competitive procurement actions.

Rejection Region: t <-1.282

Results of Hypothesis Three-B:

Considering only items procured in both periods one and two, the rate of price competition increased in period two.

A FORTRAN program was used to extract the pertinent

data from the special J041 Report and to sort it for this hypothesis test. The FORTRAN program performed the following steps:

1) Identified all procurements of all items (by NSN) that were procured in both periods one and two. Any items that were procured in only one period were eliminated from consideration.

2) Calculated the total number of both competitive and non-competitive actions fitting the above description for periods one and two.

3) Calculated the total dollar value (deflated) of both competitive and non-competitive actions fitting the above description for periods one and two.

Results of the FORTRAN program indicated that the rate of price competition increased from 22.5% of all sampled procurement actions in period one to 35% in period two, representing a 55.5% increase. Again, because of significant interaction between all variables it was important to examine other trends in interpreting this outcome. In this instance the proportion of total dollar value of all procurements of items bought in both periods that was coded as competitive procurements also increased significantly, from 18.5% in period one to 34.9% in period two, representing an 88.6% increase. In summary, of the total sample population of all procurement actions involving items procured in both periods, the proportion of both (1) the number of procurement actions and (2) the dollar value of procurement actions coded as competitive increased dramatically in period two. A summary of only those spares items procured in both periods one and two is presented in Table 17.

A test of population proportions, using the information presented in Table 17, and the supporting t-test, indicated that there was an increase in the rate of price competition in period two when considering only items procured in both periods. This test was based on a comparison of the number of competitive procurements to the number of all procurement actions for each period. Results of the test are presented in Table 18.

TABLE 17

SUMMARY OF ITEMS PROCURED IN BOTH PERIODS ONLY

Period		Competitive	Non-Competitive
1	actions	1950	6724
	dollars	$41,519,470	$182,675,416
2	actions	2830	5265
	dollars	$53,105,535	$ 99,202,331

TABLE 18

RESULTS OF HYPOTHESIS THREE-B

t-Score	Result
-18.003	Reject Ho

Ho: The rate of price competition was the same in period two as in period one, based on the number of competitive procurement actions involving only items procured in both periods.

Ha: The rate of price competition was greater in period two than in period one, based on the number of competitive procurement actions involving only items procured in both periods.

Rejection Region: t <-1.282

Results of Hypothesis Three-C:

The rate of price competition for spares items with an annual procurement value of less than $10,000 increased in period two.

A FORTRAN program was first used to extract and sort data from the special J041 report to support this test. The FORTRAN program performed the following steps:

1) Identified all procurements of all items for both periods with annual values of less than $10,000. In this instance it was not necessary that the same item (identified by NSN) be procured in both periods. The program simply identified all appropriate items that were procured in either period one or two.

2) Categorized all items identified by type of procurement action (competitive or non-competitive).

3) Categorized all items by period procured (one or two).

4) Calculated the total dollar value and total number of items procured in each of the following categories:

Period 1 - Competitive
Period 1 - Non-competitive
Period 2 - Competitive
Period 2 - Non-competitive

Table 19 presents a summary of the number of individual items procured and their associated dollar values as identified by the FORTRAN program.

A test of population proportions, utilizing information presented in Table 19, and the supporting t-test, revealed that the rate of price competition for spares with an annual procurement value of less than $10,000 did increase in period two. Tables 19 summarizes the items procured and total inflation adjusted dollar values of sampled items for both periods one and two.

TABLE 19

SUMMARY OF SPARES VALUED LESS THAN $10,000 ANNUALLY

		Competitive	Non-Competitive	Totals
Period 1	items	905,385	1,385,618	2,291,003
	dollars	$7,030,475	$28,535,153	$35,565,628
Period 2	items	1,106,160	1,656,982	2,763,142
	dollars	$10,204,933	$27,511,871	$37,716,804

Table 20 summarizes the above data as percentages of the totals for each period.

TABLE 20

SUMMARY OF ITEMS AND TOTAL DOLLAR VALUES AS PERCENTS

		Competitive	Non-Competitive	Totals
Period 1	items	39.5%	60.5%	100%
	dollars	17.4%	82.6%	100%
Period 2	items	40.0%	60.0%	100%
	dollars	27.1%	72.9%	100%

Table 21 presents the period two data (from Table 19) as percentages of period one.

TABLE 21

SUMMARY OF PERIOD TWO BUYS AS PERCENTAGES OF PERIOD ONE

		Competitive	Non-Competitive	Totals
Period 1	items	100%	100%	100%
	dollars	100%	100%	100%
Period 2	items	122.2%	119.6%	120.6%
	dollars	145.2%	96.4%	106.0%

Results of the test are presented in Table 22.

TABLE 22

RESULTS OF HYPOTHESIS THREE-C

t-Score	Result
-11.436	Reject Ho

Ho: The rate of price competition was the same in periods one and two for spares with an annual procurement value of less than $10,000.

Ha: The rate of price competition for spares with an annual procurement value of less than $10,000 was greater in period two.

Rejection Region: t <-1.282

Results of Hypothesis Four:

A change from non-competitive to competitive procurement resulted in a decrease in the price paid per unit.

A FORTRAN program and a paired t-test were used in testing this hypothesis. The FORTRAN program was used to extract the pertinent data from the special J041 Report and then sort it. The program performed the following steps:

1) Identified only items (by NSN) that were non-competitively procured in period one and also competitively procured in period two. The program handled multiple procurements of an individual item in the same period by selecting for comparison only the last non-competitive buy in period one and the first competitive buy in period two. All items were discarded from consideration unless procurements were made in both periods, the procurement in period one was non-competitive, and the procurement in period two was competitive.

2) Calculated the cost per item procured (in base year dollars) for both period one and period two actions.

3) Calculated the difference between the price paid in period one and period two per item by subtracting the price of the competitive procurement in period two from the price of the non-competitive procurement in period one.

The program identified 828 items which were procured both non-competitively in period one and competitively in period two. Having developed a difference for each selected item, a paired t-test was performed (utilizing a BMDP3D statistical package) to test the hypothesis.

Results of the paired t-test of hypothesis four revealed that a change to competitive procurement did result in a decrease in the average price paid per unit. This supports the author's expectation that a competitive procurement decreases the average price paid per item. Results of the paired t-test are presented in Table 23.

TABLE 23

RESULTS OF HYPOTHESIS FOUR

Sample Size	t-Score	Result
828 pairs 1	1.34	Reject Ho

Ho: Competition, or the lack of it, does not affect the price paid per item.

Ha: Competitive procurement results in a reduction in price paid per item compared to non-competitive procurement.

Rejection Region: t > 1.282

1 In this instance a pair means a non-competitive procurement action in period one accompanied with a competitive procurement action in period two.

Summary

Chapter IV presented a summary of the price adjusted raw data used in this research effort. Results of the analysis of overall data dependency test and results of individual tests performed for each hypothesis were presented. Additionally, the author's interpretation of the test results was presented.

V. Findings and Recommendations

Findings

The objectives of this research study were to (1) assess the effectiveness of AFLC in reducing the portion of sole-source purchases that are negotiated with other than the actual manufacturer, (2) determine if negotiating sole-source procurements with the actual manufacturer results in a savings to the government, (3) assess the effectiveness of AFLC in increasing price competition in the acquisition of spares, and (4) determine if competitive procurement actually decreases the price paid for individual spares items. Variables analyzed were price, period, quantity purchased, and method of procurement. Findings relating to these objectives follow.

The AFMAG Study identified quite a few practices that contribute to price increases. One of these factors is the pass-through cost associated with negotiating sole-source purchases with other than the actual manufacturer. While results of the hypothesis test in support of objective number one indicated that the Air Force Logistics Command has failed to reduce the portion of sole-source purchases negotiated with other than the actual manufacturer, results of the hypothesis test in support of objective number two indicated that this may not be a real problem. In fact, results of the hypothesis test supporting objective number two found no significant reduction in price associated with

negotiating sole-source procurements with the actual manufacturer. This leads to the question of whether time and financial resources spent in an attempt to negotiate sole-source purchases directly with the actual manufacturer is well spent. If the prime contractor can subcontract for these items with no price penalty to AFLC, then possibly AFLC should allow the prime to continue to do so. This would enable government resources to be utilized in other areas where cost savings are more likely to be found.

The AFMAG Study also identified factors which contribute to a low rate of price competition in the acquisition of spares. To facilitate examination of changes in the rate of price competition, items were classified into three different categories. Test A focused on all items that were procured in either period one or period two, test B on only those items procured in both periods one and two, and test C on only those items with annual procurement values of less than $10,000. A resounding rejection of the null hypothesis in all three instances indicated that AFLC has been quite successful in increasing competition, not only from an overall standpoint, but also within each of the three categories examined in this study. Further, results of the hypothesis test in support of number four indicated that the shift from non-competitive to competitive procurement has resulted in decreases in the price paid for spares items.

Implications for Air Force Managers

Results of this research effort, taken as a whole, indicate that AFLC has made progress in slowing the rapid rise in the price of replenishment spare parts through increased price competition. This would seem to indicate that the recent increased emphasis on enhancing price competition is paying off. Air Force managers must remember, however, that competition is not always practical or even possible due to economics or schedule constraints. Prevailing circumstances must be carefully considered when choosing between competitive and non-competitive procurement.

While competitive procurement does seem to result in a cost savings, efforts to negotiate sole-source purchases directly with the actual manufacturer seem to have a more questionable benefit. Actually, analysis shows no significant cost benefit. This fact, plus other considerations such as the impact on total time to procure and implications for configuration management, imply a negative benefit from efforts to buy from the actual manufacturer. From both total cost and managerial efficiency standpoints it seems that the Air Force would be better off negotiating sole-source purchases with the prime contractor.

However, there are no universal answers. The Air Force manager in today's constantly changing funding and political environments must always remember that a reasoned approach to new and continuing acquisitions, where the manager utilizes the best method of procurement possible to meet

the prevailing circumstances, is the best approach.

Recommendations

Even though results of this research effort indicate that AFLC has made progress in slowing the rapid rise in the price of replenishment spare parts by increasing price competition, more research needs to be performed in this area. This effort examined 48,126 procurement actions involving replenishment spares items procured by the Warner Robins ALC. More conclusive results could be obtained by performing a more extensive study involving additional tests as well as a larger and more diverse sample of procurement actions.

A study involving a larger and more diverse sample would help reduce the chance of sampling error and would also guard against a biased sample. Rather than an examination of procurement actions from any one ALC, it would be preferable to examine actions from all five ALCs.

In addition to a larger sample, additional questions could be addressed in future studies. For example, the average percent reduction in purchase price associated with competitive procurement could be calculated. This research found that a switch to competition resulted in a statistically significant difference in prices. However, no effort was made to quantify the price difference or to determine the economic significance of the price difference. Further research should be conducted to determine if the price

difference associated with a switch to competition is large enough to justify costs of implementation.

Costs to the government of increasing the emphasis on competition have also not been addressed. Accumulation of these costs could be the focus of an entire follow-on study. Many factors are involved, including the cost of fully dedicated competition advocacy personnel, field personnel with additional competition advocacy duties, increased processing time required for competitive procurement actions, and additional paperwork generated by the emphasis on competition are a few of these increased costs.

Once costs associated with the increased emphasis on competition have been accumulated, cost/benefit analysis could be performed to compare the cost of increased emphasis on competition to the benefits derived from increased competition. The main difficulty here would be identifying and quantifying all benefits that result from competition. This too could be the focus of a follow-on study.

Another question needing research is the probability of continued increases in competition. While the current increased emphasis on competition may have provided large benefits initially, returns may diminish as soon as all of the easily converted sole-source items are switched to competitive procurement. A realistic and measurable goal must be established. Regardless of the current emphasis on

competition, this goal must consider the social and economic constraints placed on procurements by regulations and directives such as those designed to facilitate contract awards to small and disadvantaged businesses.

Continued research could serve to verify the findings noted in this research efforts, and could also provide a wealth of new knowledge. More knowledge concerning the affect of our contracting policies and procedures would enable us to better tailor our procedures to fit the acquisition circumstances. Possibly even more important, the knowledge could be used to refute the sensational horror stories identified by the news media and the critics of the Department of Defense. Today, for example, we may be revamping our entire contracting system to prevent horror stories that occur in only extremely isolated instances that are of no real monetary significance when expressed as a percentage of overall expenditures. The cost of the revamping in personnel, funds, and the managerial reputation of the Defense Department is staggering, but worst of all, it may be misdirected.

Bibliograhpy

1. Bass, William K. and D. J. Schmitt. An Analysis of Causes of Contract Price Change For Competitive Procurements of Replenishment Spare Parts, Unpublished Master's Thesis, Air Force Institute of Technology, Wright-Patterson AFB OH, 1984.

2. Brost, Edward J. A Comparative Analysis of Sole Source Versus Competitive Prices in the Acquisition of Weapon System Replenishment Spare Parts. MS Thesis, LSSR 51-82. School of Systems and Logistics, Air Force Institute of Technology, Wright-Patterson AFB OH, September 1982 (AD-A122 982).

3. Bureau of Labor Statistics. Producers Prices and Price Indexes. Washington: Government Printing Office, 1983 and 1984.

4. Cunningham, James A., et. al. A Cost-Benefit Analysis of Competitive Versus Sole-Source Procurement of Aircraft Replenishment Spare Parts, Unpublished Master's Thesis, Air Force Institute of Technology, Wright-Patterson AFB OH, 1974.

5. Department of Defense. Competition Acquisitions. DOD Directive 4245.9. Washington: Government Printing Office, 17 August 1984.

6. Department of Defense, Defense Systems Management College. Establishing Competitive Production Sources -- A Handbook for Program Managers". Fort Belvoir VA, August 1984.

7. Department of the Air Force. Air Force Competition Advocate Program. AFR 800-35. Washington: HQ USAF, 12 October 1984.

8. Department of the Air Force, Air Force Logistics Command. Directorate of Competition Advocacy. AFLCR 23-49. HQ AFLC, 29 August 1984.

9. Department of the Air Force, Air Force Logistics Command. Acquisition and Due-In System. AFLCR 70-11. HQ AFLC, 10 April 1981.

10. Department of the Air Force, Air Force Logistics Command. "Command Competition Goals," Policy Letter dated 26 December 1984.

11. Department of the Air Force, Air Force Management Analysis Group (AFMAG). Spare Parts Acquisition--Final

Report, Executive Summary. HQ USAF/IG-AFMAG, 12 October 1983.

12. Department of the Air Force, Air Force Management Analysis Group. Spare Parts Acquisition--Final Report, Problem and Recommendations. HQ USAF/IG-AFMAG, 12 October 1983.

13. McClave, James T. and P. George Benson. Statistics for Business and Economics (Second Edition). San Francisco: Dellen Publishing Company, 1982.

14. Office of Federal Procurement Policy (OFPP). Noncompetitive Procurement Procedures. Policy Letter 84-2, February 27, 1984.

15. Office of the President of the United States of America. Memorandum for the Heads of Departments and Agencies: "Competition in Federal Procurement", 11 August 1983.

16. Pace, Dean F. Negotiation and Management of Defense Contracts. New York: John Wiley and Sons, Inc., 1970.

17. School of Systems and Logistics. Compendium of Authenticated Systems and Logistics Terms, Definitions and Acronyms. AU-AFIT-LS-3-81. Wright-Patterson AFB OH: Air Force Institute of Technology (AU), 1981.

18. Stitzel, Stephen, Procurement Analyst, Office of Assistant to the Commander for Competition Advocacy, AFLC. Personal interview. 9 November 1984.

19. U.S. Army Electronics Command Study, "The Cost Effects of Sole Source Versus Competitive Procurement," U.S. Army Electronics Command, Cost Analysis Division, February, 1972.

VITA

Captain Jerry G. Gable was born on 29 November 1950 in Lexington, South Carolina. He graduated from high school in Batesburg, South Carolina, in 1969 and attended the University of South Carolina from which he received the degree of Bachelor of Science in Accounting in 1978. He was commissioned upon completion of Officer Training School on 10 March 1980. He first served as resource manager under the Deputy for Comptroller, Arnold Air Force Station, Tennessee from March 1980 through February 1983. He served as Chief of Configuration Management, Program Control Division, Aeropropulsion Systems Test Facility (ASTF), Arnold Air Force Station, Tennessee, from March 1983 until entering the School of Logistics, Air Force Institute of Technology, in May 1984.

Permanent address: 140 Culbreth Lane
West Columbia, SC 29169

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

AD-A161 065

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) AFIT/GLM/LSA/85S-25	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION School of Systems and Logistics 6b. OFFICE SYMBOL (If applicable) AFIT/LSA	7a. NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State and ZIP Code) Air Force Institute of Technology Wright-Patterson AFB, Ohio 45433	7b. ADDRESS (City, State and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State and ZIP Code)	10. SOURCE OF FUNDING NOS. PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT NO.
11. TITLE (Include Security Classification) See Box 19	
12. PERSONAL AUTHOR(S) Jerry G. Gable, B.S., Capt, USAF	
13a. TYPE OF REPORT MS Thesis 13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Yr., Mo., Day) 1985 September 15. PAGE COUNT 77
16. SUPPLEMENTARY NOTATION	

17. COSATI CODES		
FIELD	GROUP	SUB. GR.
01	03	
15	05	

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Spare Parts, Air Force Procurement, Military Procurement, Acquisition

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Title: THE RAPID RISE IN THE COST OF REPLENISHMENT SPARE PARTS: ARE WE MAKING PROGRESS?

Thesis Chairman: Matthew D. Shields, Lt Col, USAF
Assistant Professor of Quantitative Methods

Approved for public release: IAW AFR 190-1.
LYNN E. WOLAVER
Dean for Research and Professional Development
Air Force Institute of Technology (AFIT)
Wright-Patterson AFB OH 45433
11 Sept 85

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Matthew D. Shields, Lt Col, USAF	22b. TELEPHONE NUMBER (Include Area Code) 513-255-5435 22c. OFFICE SYMBOL AFIT/LSM

DD FORM 1473, 83 APR EDITION OF 1 JAN 73 IS OBSOLETE.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

The cost of spare replenishment parts has been rapidly increasing in recent years, and this trend has adversely affected Air Force readiness and sustainability. This thesis project was an effort to determine the success of recent initiatives taken by the Air Force Logistics Command in controlling prices of these spare replenishment parts. Procurement actions performed by the Warner Robins Air Logistics Center in two different periods were examined to answer the following specific questions:
(1) Has AFLC been successful in reducing the portion of sole-source purchases that are negotiated with other than the actual manufacturer?
(2) Does negotiating sole-source procurements with the actual manufacturer result in savings?
(3) Has AFLC been successful in increasing price competition in the acquisition of spares?
(4) Does competitive procurement actually decrease the price paid?
Findings and recommendations relating to the above questions complete the research effort.

END

FILMED

12-85

DTIC